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## NOTES AND MEMORANDA

### THE TRUSTWORTHINESS OF THE BUREAU OF LABOR'S INDEX NUMBER OF WAGES

DOUBTS concerning the trustworthiness of the index number of wages compiled by the federal Bureau of Labor were aroused in 1903 by the publication of Professor Davis R. Dewey's census report upon *Employees and Wages*. Professor Dewey, indeed, did not cast his statistical data into summaries directly comparable with the Bureau's results; but his detailed tables and his comments upon conditions in industry after industry indicated that net reductions in wages between the census years 1890 and 1900 had been quite as numerous as net increases. According to the Bureau of Labor, on the contrary, wages stood decidedly higher in 1900 than in 1890. The index number, based on average rates of pay per hour in 1890-99, was 105.5 in the later and 100.3 in the earlier year. Thus there seemed to be a discrepancy between the results of the two investigations.

This impression was made more definite in 1907 by Professor Henry L. Moore's study of "The Variability of Wages."<sup>1</sup> Basing his work upon Dewey's data, Moore computed the average rate of wages in 30 selected industries in the years 1890 and 1900, and found that relative wages had declined from 100.0 to 99.6. Like Dewey, Moore said nothing about the discrepancy between his own figures and those of the Bureau of Labor; but he owned himself surprised at getting results "so utterly at variance with what is commonly thought as to the movement of wages."<sup>2</sup>

<sup>1</sup> Political Science Quarterly, March, 1907, pp. 61-73.

<sup>2</sup> Ibid., p. 68. To make sure of the arithmetical accuracy of his work, Professor Moore repeated the computations by a slightly different method, and arrived again at the same ratios of 100.0 in 1890 and 99.6 in 1900.

Others, less cautious than Dewey and Moore, have discredited the Bureau's results because of this discrepancy. The extreme care with which Dewey's material was collected and the impartiality with which it was analyzed favored the opinion that in case of disagreement the Bureau must be wrong. Insinuations were not wanting that the Bureau had selected its data with the set purpose of making out an advance in wages.<sup>1</sup>

Desiring to use the Bureau's index number of wages in a study of business cycles, I recently had occasion to test the trustworthiness of the figures. Previous experience in dealing with the prices of labor and of commodities indicated that different collections of data, made in good faith, representative in scope, and analyzed by similar methods, yield substantially similar results.<sup>2</sup> The problem was to determine whether the discrepancy between the results obtained from the Bureau's collection of wage statistics and from Dewey's collection was due to dissimilarity in the methods of analysis, dissimilarity in scope, or dissimilarity in the original data.

Examination showed that Moore's table differed from the Bureau's table in several respects. Moore took wages per week, the Bureau wages per hour; Moore excluded females, the Bureau included them; Moore covered 30 industries, the Bureau 56; Moore weighted his figures by actual numbers employed, the Bureau did not weight its figures for different occupations in striking averages for each industry, but did weight its figures for different industries in striking grand averages; finally, Moore computed averages in one way, the Bureau in another. Moore began by tabulating the number of men receiving \$2-3 a week, \$3-4, \$4-5, and so on. Then he multiplied the mean wage in each of these groups (\$2.50, \$3.50, \$4.50) by the

<sup>1</sup> See, for example, Ernest Howard, "Inflation and Prices," *Political Science Quarterly*, March, 1907, p. 81.

<sup>2</sup> Compare Gold, Prices, and Wages under the Greenback Standard, pp. 203-218, and "The Dun-Gibson Index Number," *Quarterly Journal of Economics*, November, 1910, pp. 161-172.

corresponding number of employees. To find the average actual wages, he divided the sums of these products by the total number of men represented, and then turned the average actual wages into percentages. The Bureau, on the other hand, turned its actual wages per hour into percentages at the outset, and then made arithmetic means from these percentages by the curious combination of simple and weighted averaging which has been stated.

All these differences in scope and method proved capable of substantial elimination in fresh computations based upon the Bureau's data and summarized in the accompanying table. The actual wages per hour in 1890 and 1900 were multiplied by the number of working hours per week in each year to get wages per week. The industries not covered by Moore and all series for females were rejected.<sup>1</sup> The figures were weighted by the numbers reported as employed in each occupation, the data were distributed in the groups used by Moore, and average wages were computed after his fashion. The result was an average weekly wage of \$13.01 in 1890, and \$13.05 in 1900. These actual wages correspond to relative wages of 100.0 in 1890, and 100.3 in 1900, — figures which are almost the same as Moore's relative wages of 100.0 and 99.6.<sup>2</sup>

The practical identity of these results confirms confidence in the integrity and in the representative character of both

<sup>1</sup> The industries included as corresponding to Moore's were Agricultural implements, Bakeries, Boots and shoes, Boots and shoes — rubber, Candy, Carpets, Carriages and wagons, Cars — steam railroad, Clothing — factory product, Cotton goods, Dyeing, Flour, Foundry and machine shops, Furniture, Glass, Hosiery and knit goods, Iron and steel — all branches, Leather, Liquors — malt, Lumber, Musical instruments — pianos, Paper and wood pulp, Planing mills, Pottery, Printing — book and job, Shipbuilding, Slaughtering, Tobacco — cigars, Tobacco — plug, Woolen and worsted goods.

<sup>2</sup> Moore's actual wages were \$11.57 in 1890 and \$11.52 in 1900; but the difference between these results and those obtained from the Bureau's data is no cause for misgiving. For the Bureau of Labor did not collect its statistics with the purpose of determining the average actual rates of pay prevailing in different years, but with the purpose of determining the average rates of change in wages from one year to the next. Had it aimed at determining actual rates, the Bureau would have made a much more elaborate examination of the number of persons employed at the different rates. That it did not accomplish an object at which it did not aim, does not impair confidence in the results which it did seek to establish.

THE DISTRIBUTION OF WAGES IN THIRTY MANUFACTURING INDUSTRIES, ACCORDING TO THE DATA OF THE BUREAU OF LABOR

Rates of wages per week	1890		1900	
	No. of wage-earners	Percentage of whole number	No. of wage-earners	Percentage of whole number
\$2— 2.99	81	.12	..	..
3— 3.99	26	.04	215	.25
4— 4.99	..	..	20	.02
5— 5.99	274	.41	239	.28
6— 6.99	706	1.07	711	.83
7— 7.99	2,482	3.75	3,041	3.54
8— 8.99	7,080	10.69	7,882	9.18
9— 9.99	2,503	3.78	10,113	11.78
10—10.99	8,297	12.53	5,249	6.11
11—11.99	797	1.20	2,406	2.80
12—12.99	9,136	13.80	10,689	12.45
13—13.99	5,733	8.66	4,325	5.04
14—14.99	8,546	12.91	14,948	17.41
15—15.99	14,465	21.84	15,788	18.39
16—16.99	3,638	5.49	5,636	6.56
17—17.99	301	.45	1,756	2.05
18—18.99	252	.38	427	.50
19—19.99	216	.33	360	.42
20—20.99	60	.09	503	.59
21—21.99	491	.74	53	.06
22—22.99	105	.16	116	.14
23—23.99	56	.08	99	.12
24—24.99	201	.30	79	.09
25—25.99	39	.06	140	.16
26—26.99	480	.73	21	.02
27—27.99	33	.05	336	.39
28—28.99	68	.10	..	..
29—29.99	6	.01	..	..
30—30.99	38	.06	498	.58
31—31.99	15	.02	23	.03
32—32.99	13	.02	42	.05
33—33.99	..	..	3	.00
34—34.99	..	..	66	.08
35—35.99	..	..	29	.03
36—36.99	47	.07	6	.01
37—37.99	..	..	..	..
38—38.99	..	..	..	..
39—39.99	..	..	1	.00
40—40.99	30	.05	..	..
41—41.99	..	..	..	..
42—42.99	..	..	..	..
43—43.99	5	.01	..	..
44—44.99	..	..	..	..
45—45.99	..	..	33	.04
46—46.99	..	..	..	..
47—47.99	..	..	..	..
48—48.99	..	..	..	..
49—49.99	..	..	..	..
Total .....	66,220	100.00	85,853	100.00

investigations. Tho made at different times, by different agents acting under different directions, and tho obtained in part from different establishments, the two collections of data yield the same conclusion when they are given the same scope and analyzed in the same way.

## II

But, granted that the Bureau's original data are trustworthy, can the same be said of the Bureau's index number? Which methods of analysis are preferable — the Bureau's methods, which make out an advance of relative wages from 100.3 in 1890 to 105.5 in 1900, or Moore's methods, which reduce the advance almost to zero?

In most respects, the advantage is all with the Bureau of Labor.<sup>2</sup> (1) It is better to give data separately for the number of working hours per week and for the wages per hour, than to lump the two together as wages per week. Tables like Moore's effectually conceal the increased leisure which the working class won between 1890 and 1900 — a decided gain in itself, whether weekly wages increased or not. The Bureau of Labor shows definitely the degree of this gain, and also shows that the reduction of hours partly offsets the advance in money income arising from increased wages per hour. (2) It is clearly better to include females as well as males, and (3) better to include as many industries as possible — provided always that satisfactory data are available. (4) In measuring average rates of change, it is better to reduce the actual wages to percentages in the first place, as the Bureau does, and then to average these percentages, than it is to begin by computing average actual wages as Moore does, and then to reduce these actual wages to percentages. For there is danger that in averaging

<sup>2</sup> It should be noted that the chief aim of Professor Moore's investigation was to determine the relative variability of wages on the two census years, and that his average wages were made to serve this purpose. Hence the following demonstration that the change in average wages is not the most accurate measure of average change in wages affects neither the validity nor the importance of Professor Moore's main contentions.

actual wages a relatively small change in the wages of highly paid men may offset a relatively large change in the wages of poorly paid men. Moreover, average actual wages for men following unlike occupations in different industries are notoriously delusive. The results are determined by the numbers reported as receiving each of the specified rates of pay, and it is exceedingly difficult to make sure that the number of men for whom satisfactory pay rolls can be had are representative of the numbers actually employed at each rate. To approximate the average rate of rise or fall in wages is a more feasible aim than to approximate the average actual wage, and the Bureau of Labor has been well advised in limiting its efforts to the former.<sup>1</sup> (5) Moore's plan of distributing his data in groups according to weekly rates of wages with fifty-cent or dollar intervals was forced upon him by the tables of his source. But the procedure may distort the average; for changes in wages which do not transfer wage-earners from one group to another cannot appear, and small changes on the margin between two groups are magnified into changes from the mean of one group to the mean of the next.

But there is one point at which Moore's method is more logical than the Bureau's. As has been said, Moore weights the mean of each of his wage-groups by the number of men contained within the group, while the Bureau pays no attention to the unlike number of persons following each occupation in computing the average relative wages for the separate industries. To treat occupations followed by a score of men as equal in statistical importance to occupations followed by hundreds or by thousands is theoretically indefensible, when the aim is to measure the average change in wages.<sup>2</sup> But the practical effect of this error in method is not great. Two computations, alike in all respects except

<sup>1</sup> "Methods of Presenting Statistics of Wages," *Quarterly Publications of the American Statistical Association*, Dec., 1905; vol. ix, pp. 328-329.

<sup>2</sup> Of course, no errors which this procedure introduces into the averages for any industry are corrected when the Bureau, in striking its grand averages, subsequently weights the figures for each industry by the census returns for the aggregate sums paid out in wages.

that in the first occupations are treated by the Bureau's plan, and that in the second occupations are weighted by the numbers employed, give nearly the same grand averages. The first makes relative wages per hour in 1890 and 1900 100.5 and 105.3 respectively, while the second makes the figures 100.7 and 105.0.

This review of the methods followed by Professor Moore and by the Bureau of Labor suggests that the averages obtained in the preceding table by applying Moore's methods to the Bureau's data may misrepresent the facts.

The table has, in fact, one merit and several defects. It corrects the Bureau's error of treating all occupations alike, irrespective of the number of employees; for in this table every occupation counts in proportion to the number of men for whom the Bureau of Labor collected pay rolls in 1890 and 1900. The defects of the table arise from the use of Moore's methods. (1) If the artificial grouping of the data is dropped and average wages are computed accurately by multiplying the exact weekly wages in each occupation by the number of recipients, before adding the products and dividing by the whole number of wage-earners, the results are changed from 100.0 in 1890 and 100.3 in 1900 to 100.0 and 100.9 respectively. (2) If actual wages are converted into percentages at the outset, on the basis of average rates for 1890-99, the results are further changed to 101.7 and 103.2. (3) If this change in weekly rates is analyzed, it is found to result from an average reduction of relative hours per week from 100.7 in 1890 to 99.5 in 1900, and from an average increase in relative wages per hour from 101.0 to 103.7. (4) Males in 26 industries covered by the Bureau of Labor, but not by Moore, received an average increase in rates per hour from 98.9 to 107.5 and (5) females, not included by Moore, received a corresponding increase from 98.5 to 105.5. Each of these corrections serves to make the average rise of wages greater — to bring the figures closer to the Bureau's results and remove them further from Moore's. Summing up all the changes and including all the material,



we have an average reduction of relative hours from 101.1 to 98.2, an average increase in relative wages per hour from 99.9 to 105.3, and an average increase in relative wages per week from 101.0 to 103.4. These results are all so close to the Bureau's own figures that it makes little difference which are used.

The Bureau's data have been submitted to one further test. In the preceding computation the industries as well as the occupations are weighted by the number of men for whom pay rolls were obtained in 1890 and in 1900. It may be better to use these weights only in striking averages for each industry, and then to weight the average for each industry by the census returns for number of employees in 1900. If grand averages are made up in this way, they show a reduction in relative hours per week from 100.6 to 98.7, an increase in relative wages per hour from 100.7 to 105.0, and an increase in relative wages per week from 101.3 to 103.6. Again, the increase in wages is only a trifle smaller than that found by the Bureau of Labor.<sup>1</sup>

Clearly, then, the results which Professor Moore deduced from Professor Dewey's report afford no reason for doubting that the Bureau of Labor's index number represents fairly the trend of wages in manufacturing industries. On the contrary, the former investigation bears convincing testimony to the high character of the latter.

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<sup>1</sup> The Bureau's results for 1890 and 1900 are, relative hours per week 100.7 and 98.7, relative wages per hour 100.3 and 105.5, relative wages per week 101.0 and 104.1.